Outline

• Mission Overview and upcoming Events
• FY 2016 Appropriation
• FY 2017 President’s Budget
• Discovery, New Frontiers, and Mars Exploration Program
• Europa mission
• Cubesats Selections
• Planetary Defense Coordination Office
Planetary Science Missions Events

2014
July – Mars 2020 Rover instrument selection announcement
August 6 – 2nd Year Anniversary of Curiosity Landing on Mars
September 21 – MAVEN inserted in Mars orbit
October 19 – Comet Siding Spring encountered Mars
September – Curiosity arrives at Mt. Sharp
November 12 – ESA’s Rosetta mission lands on Comet Churyumov–Gerasimenko
December 2/3 – Launch of Hayabusa-2 to asteroid 1999 JU3

2015
March 6 – Dawn inserted into orbit around dwarf planet Ceres
April 30 – MESSENGER spacecraft impacted Mercury
May 26 – Europa instrument Step 1 selection
July 14 – New Horizons flies through the Pluto system
September – Discovery 2014 Step 1 selection
December 6 – Akatsuki inserted into orbit around Venus

2016
March – Launch of ESA’s ExoMars Trace Gas Orbiter (Launch of NASA’s InSight postponed)
July 4 – Juno inserted in Jupiter orbit
September – Launch of Asteroid mission OSIRIS–REx to asteroid Bennu
September – Cassini begins plane change maneuver for the “Grand Finale”
Late 2016 – Discovery 2014 Step 2 selection
FY16 Appropriation supports a robust Planetary Science program

Planetary Science $270M above the request, at $1.63B
- $277M for Planetary Science Research
- $189M for Discovery (+$33M), including full funding for LRO
- $259M for New Frontiers
- $448M for Mars (+$36M), including full funding for Opportunity
- $197M for Technology (+$55M)
  - Includes $25M for icy satellites surface technology
- $261M for Outer Planets (+$145M) with direction
  - Directs that the Europa mission be launched on an SLS in 2022 and that a lander be included ($175M)
- Direction to continue to fund AIDA/DART joint study with ESA
- Direction to establish a new Ocean Worlds program with a primary goal to discover extant life on another world using a mix of Discovery, New Frontiers, and flagship class missions
Continues development of the Mars 2020 mission.

Funds continued formulation of a mission to Jupiter’s moon, Europa.

Continues work on the JUICE instrument in collaboration with the European Space Agency mission to Jupiter.

- Initiates studies for the next New Frontiers Mission and continues operations of Juno and New Horizons.
- Operates 13 Planetary missions including MAVEN, Mars Curiosity, Opportunity, Odyssey, Mars Express, and Cassini (Saturn).
- Increases support for technology development to accelerate future power systems.
- Increases support for Research and Analysis.
Discovery Program
Discovery Program

Completed

Mars evolution:
Mars Pathfinder (1996-1997)

Lunar formation:

NEO characteristics:
NEAR (1996-1999)

Solar wind sampling:
Genesis (2001-2004)

Completed

Comet diversity:
CONTOUR (2002)

Nature of dust/coma:
Stardust (1999-2011)

Comet internal structure:

Lunar Internal Structure
GRAIL (2011-2012)

Completed

Mercury environment:

Main-belt asteroids:
Dawn (2007-2016)

Lunar surface:
LRO (2009-TBD)

ESA/Mercury Surface:
Strofio (2017-TBD)

Mars Interior:
InSight (TBD)
Discovery Selections 2014

Psyche: Journey to a Metal World
PI: Linda Elkins-Tanton, ASU
Deep-Space Optical Comm (DSOC)

VERITAS: Venus Emissivity, Radio Science, InSAR, Topography, And Spectroscopy
PI: Suzanne Smrekar, JPL
Deep-Space Optical Comm (DSOC)

NEOCam: Near-Earth Object Camera
PI: Amy Mainzer, JPL
Deep-Space Optical Comm (DSOC)

Lucy: Surveying the Diversity of Trojan Asteroids
PI: Harold Levison, Southwest Research Institute (SwRI)
Advanced Solar Arrays

DAVINCI: Deep Atmosphere Venus Investigations of Noble gases, Chemistry, and Imaging
PI: Lori Glaze, GSFC
New Frontiers Program
New Frontiers Program

1\textsuperscript{st} NF mission
New Horizons:
Pluto-Kuiper Belt
Launched January 2006
Flyby July 14, 2015
PI: Alan Stern (SwRI-CO)

2\textsuperscript{nd} NF mission
Juno:
Jupiter Polar Orbiter
Launched August 2011
Arrives July 4, 2016
PI: Scott Bolton (SwRI-TX)

3\textsuperscript{rd} NF mission
OSIRIS-REx:
Asteroid Sample Return
Launch window: Sept. 8, 2016
PI: Dante Lauretta (UA)
Next New Frontiers Program AO

• Community Announcement Regarding New Frontiers Program issued in January 2016
• Draft to be released by end of Fiscal Year 2016 (September)
• Investigations are limited to the following mission themes (listed without priority):
  – Comet Surface Sample Return
  – Lunar South Pole-Aitken Basin Sample Return
  – Ocean Worlds (Titan, Enceladus)
  – Saturn Probe
  – Trojan Tour and Rendezvous
  – Venus In Situ Explorer
Next New Frontiers AO Time Frame

Notional Schedule:

- Release of final AO............................ January 2017 (target)
- Preproposal conference...................... ~3 weeks after final AO release
- Proposals due .................................. ~90 days after AO release
- Selection for competitive Phase A .... November 2017 (target)
- Concept study reports due............... October 2018 (target)
- Down-selection ................................. May 2019 (target)
- KDP B ............................................. August 2019 (target)
- Launch readiness date ...................... 2024
New Frontiers 4 OW Targets

• Why was the Ocean Worlds mission theme added to NF4?
  1. NOSSE Report: As a strategic program NF should be “adaptable to new discoveries”
  2. Consistent with V&V Planetary Decadal: “A decadal survey should not be blindly followed if external circumstances dictate that a change in strategy is needed.”
  3. Very strong science case for Enceladus and Titan
  4. Congressional FY16 Approps: Response is required

• Next Steps:
  – Presented decision and rationale to PSS for feedback (considering AG input)
  – Will present decision and rationale to CAPS for feedback – midterm charge will also address how to accommodate recent discoveries
  – Community can also comment via the draft AO process
Mars Exploration Program
Program Overview

• Our operational assets remain healthy and productive:
  – MAVEN has successfully completed its prime science mission and is now continuing investigations in an extended mission
  – Odyssey continues to be healthy and contribute thermal imagery and data relay services
  – MRO continues to provide invaluable reconnaissance imaging and mineralogical mapping, supporting science investigations, rover operations, and exploring potential human landing sites
  – Opportunity continues to provide important ground truth data, recently scaling 30° slopes of Knudsen Ridge atop the southern flank of Marathon Valley
  – Curiosity at Gale Crater, generating important insights into Martian chemistry
  – Mars Express continues operating our deep radar sounder (MARSIS)

• M2020 development on-track and proceeding well:
  – PDR successfully completed Feb 2016
  – Heritage H/W fabrication underway; some delivered
  – Sampling system development labs up and running

• Our foreign commitments are on track
  – Our two Electra payloads on the TGO are ready for flight
  – MOMA is proceeding in development for the ExoMars Lander
Next Orbiter (Under Study): Provide Capabilities that enable many Future Pathways

- Aging Orbiter Missions
- On-going and future Surface Missions – need orbital support

Timely Renewal and Enhancement of Infrastructure is needed to Support Future Missions
Desired Orbiter Capabilities

- Renew and Update Aging Communications Infrastructure
  - Essential to the future of Mars exploration; Laying the foundation for missions to come, while supporting ongoing missions in the early 2020’s

- Provide Continuity of High Resolution Imaging
  - Scientific Investigations for Landing Site Certification

- Emplace Essential Orbital Support for Sample Return

- Opportunity for Resource Prospecting for future Landing Sites and Exploration planning

- Other Relevant Remote Sensing Opportunities
Europa Mission
Europa Multi-Flyby Mission Concept Overview

- **Science**
  - **Objective**
  - **Description**
    - **Ice Shell & Ocean**: Characterize the ice shell and any subsurface water, including their heterogeneity, and the nature of surface-ice-ocean exchange.
    - **Composition**: Understand the habitability of Europa's ocean through composition and chemistry.
    - **Geology**: Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities.
    - **Recon**: Characterize scientifically compelling sites, and hazards for a potential future landed mission to Europa.

- **Conduct 45 low altitude flybys with lowest 25 km (less than the ice crust) and a vast majority below 100 km to obtain global regional coverage**

- **Traded enormous amounts of fuel used to get into Europa orbit for shielding (lower total dose)**

- **Simpler operations strategy**

- **No need for real time down link**

**Lander Concept Studies Are Continuing**
SIMPLEEx Cubesats Selections
Full missions (2)
and
Approved for 1 year Tech Development (3)
Small Innovative Missions for Planetary Exploration (SIMPLEX-2014) – New Awards in FY15

**Lunar Polar Hydrogen Mapper (LunaH-Map)**
PI: Craig Hardgrove
ASU School of Earth and Space Exploration

**CubeSat Particle Aggregation and Collision Experiment (Q-PACE)**
PI: Josh Colwel
University of Central Florida
Simplex Cubesats
Approved for Tech Development (1 year) Study ONLY

Mars Micro Orbiter
 PI: Michael Malin
 Malin Space Science Systems

Diminutive Asteroid Visitor using Ion Drive (DAVID)
 PI: Geoffrey Landis
 NASA Glenn Research Center

Hydrogen Albedo Lunar Orbiter (HALO)
 PI: Michael Collier,
 NASA GSFC
Planetary Defense Program
Planetary Defense Coordination Office (PDCO)

Hosted by the Planetary Science Division PDCO is responsible for:

• Oversight of potentially hazardous objects (PHOs):
  – Ensure early detection
  – Characterize PHOs of size large enough to affect Earth’s surface
  – Provide warning of potential impact effects if not deflected or mitigated
  – Provide timely and accurate communications about PHOs and any potential impact

• Lead research into potential asteroid deflection and impact mitigation technologies and techniques

• Provide lead coordination role in U.S. Gov’t planning for response to an actual impact threat (e.g., planetary science and deep space mission expertise for Federal Emergency Response Team)
Questions?